Preliminary Investigation of Civil Tiltrotor in NextGen Airspace

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Rotorcraft in the Next Gen Airspace



- Demonstrate analytically that rotorcraft can be successfully integrated into Next Gen airspace
- Identify unique Next Gen technologies and concepts of operations that might be required to maximize safe, efficient, environmental responsive, and economic employment of rotorcraft in the Next Gen airspace
- Demonstrate with modern, accepted analysis/simulation tools that rotorcraft can be a potential solution to airport/airspace congestion
- Provide insights into rotorcraft-specific technology advances that will be required

Making Sure Rotorcraft Requirements are Factored into Next Gen Tech & CONOPS



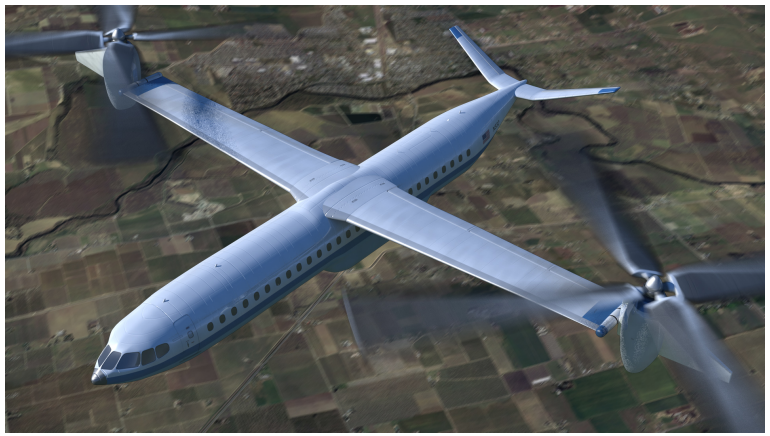
- Primary emphasis of Next Gen implementation is, not unexpectedly, on subsonic fixed-wing jet aircraft
- It is vitally important to ensure that rotorcraft requirements are adequately factored into Next Gen technologies and concepts of operation
- Without proper attention to rotorcraft-specific technology and operational questions and issues the full potentiality of future rotorcraft systems might not be realized

NASA Airspace Systems' NRA Effort

- Ongoing Airspace Systems-sponsored "Advanced Vehicles in Next Gen Airspace" study; in the final few months of an 18-month study effort by two contractor teams

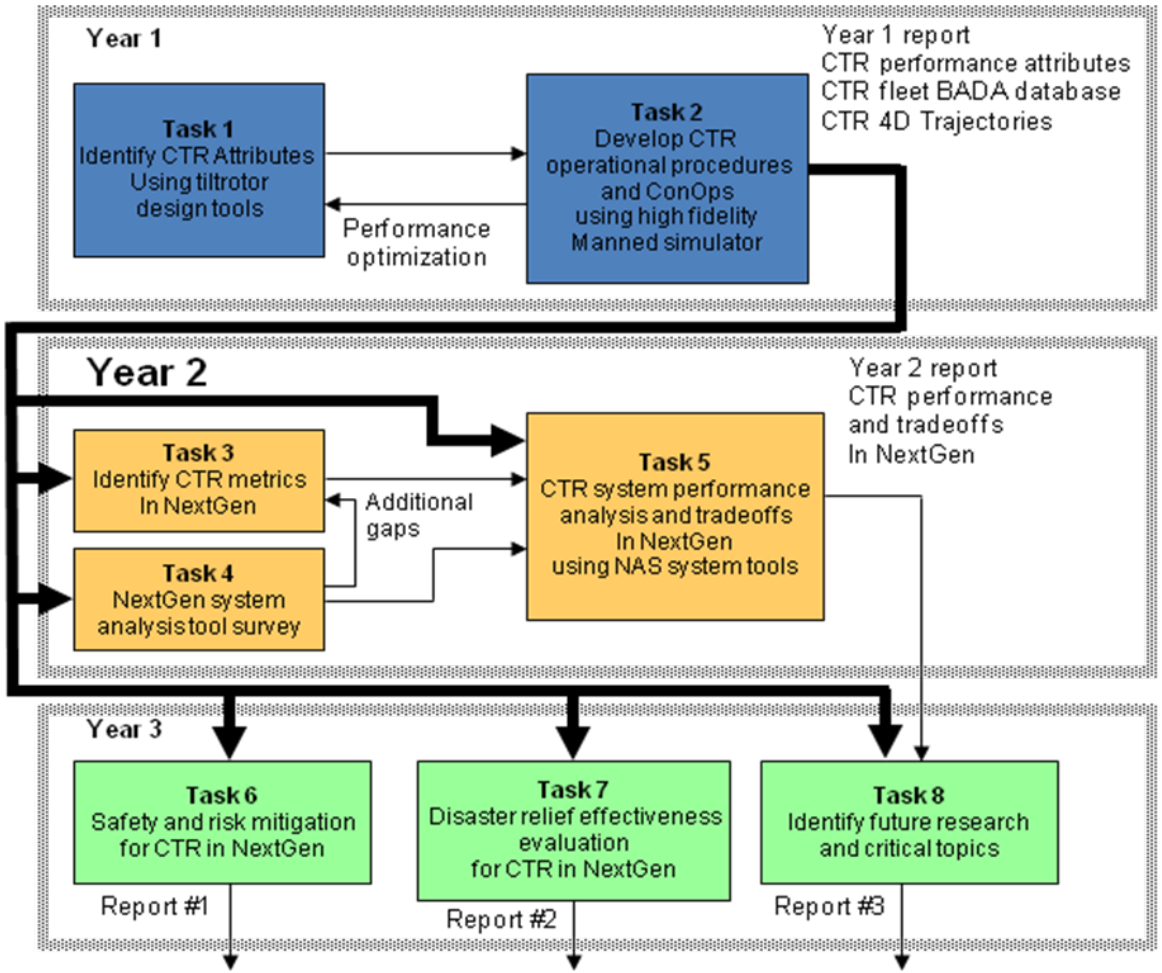
- NASA provided Sensis-led NRA team 90-PAX LCTR2 reference design for airspace modeling effort‡

- But consensus within SRW is that NRA Effort needs to be expanded upon -- that led to the initiation of SRW-sponsored "Civil Tiltrotor (CTR) in Next Gen" study



‡Acree, C.W., Yeo, H., and Sinsay, J.D., "Performance Optimization of the NASA Large Civil Tiltrotor," AIAA/AHS/SAE International Powered Lift Conference, July 2008.

“CTR in Next Gen” Study Tasks



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Not One, but a Family of Vehicles Being Studied



- CTR airspace simulations will be based on a fleet of 10-, 30-, 90-, and 120-PAX vehicles
- 10- and 30-PAX vehicle design heritage based, in part, on BA-609 and V-22
- 90- and 120-PAX vehicles will be clean-sheet conceptual designs based on Bell Helicopter technology projections for IOP's of 2020.
- Additionally, both VTOL and STOL takeoff and landing profiles will be incorporated in the pilot-in-the-loop and airspace simulations
- Bell PRESTO sizing analysis used for vehicles

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Progress to Date



- Nine months into Year 2 effort
- Design requirements for family of CTR vehicles agreed to by team
- Conceptual designs completed for 10-, 30-, and 120-PAX vehicles
- Demand modeling and informal team assessments established a baseline fleet size for vehicles for 2025 time frame
- Given design data, BADA models are developed
- Pilot-in-the-loop simulations completed
- Coupled ACES/AvTerminal airspace simulations have begun

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General Conceptual Design Requirements

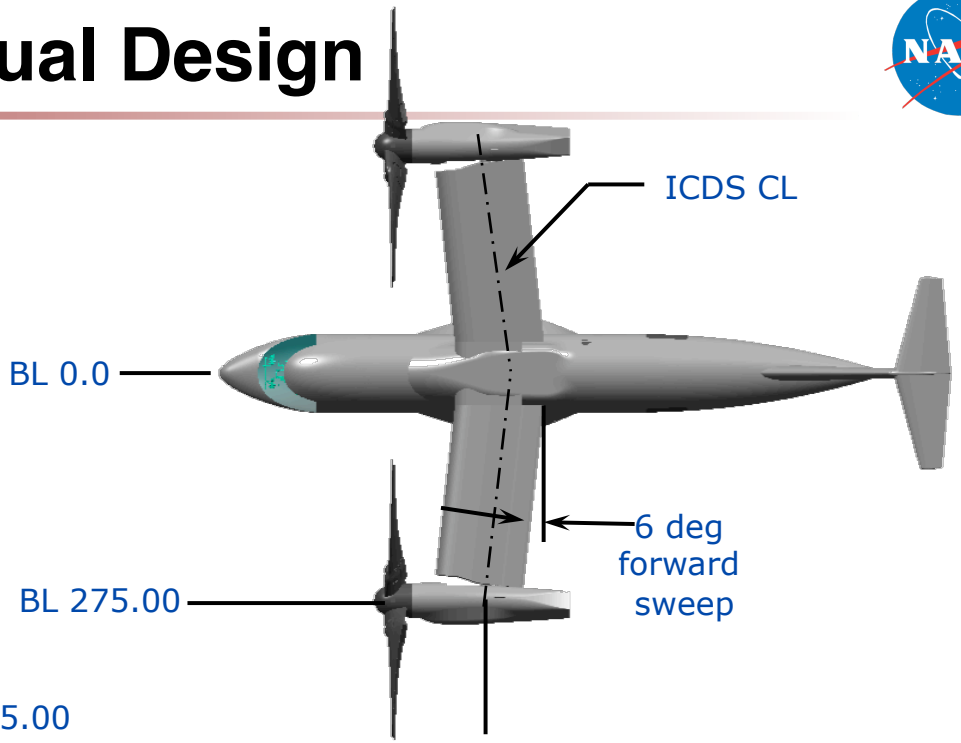
Number of Pax		10	30	90	120
Takeoff Condition	5k/Hot	-->	-->	-->	
Takeoff Procedure (1)	VTOL	VTOL	VTOL	VTOL	
Takeoff Configuration	Helo	Helo	Helo	Helo	
Payload, lbs	2200	6600	19800	26400	
Design Range, nm	800 (2)	1000 (2)	1000	1200	
Cruise Altitude, 1000 ft	25	25	30 (2)	27.5	
Cruise Speed, ktas	Fallout	Fallout	300 (2)	345	

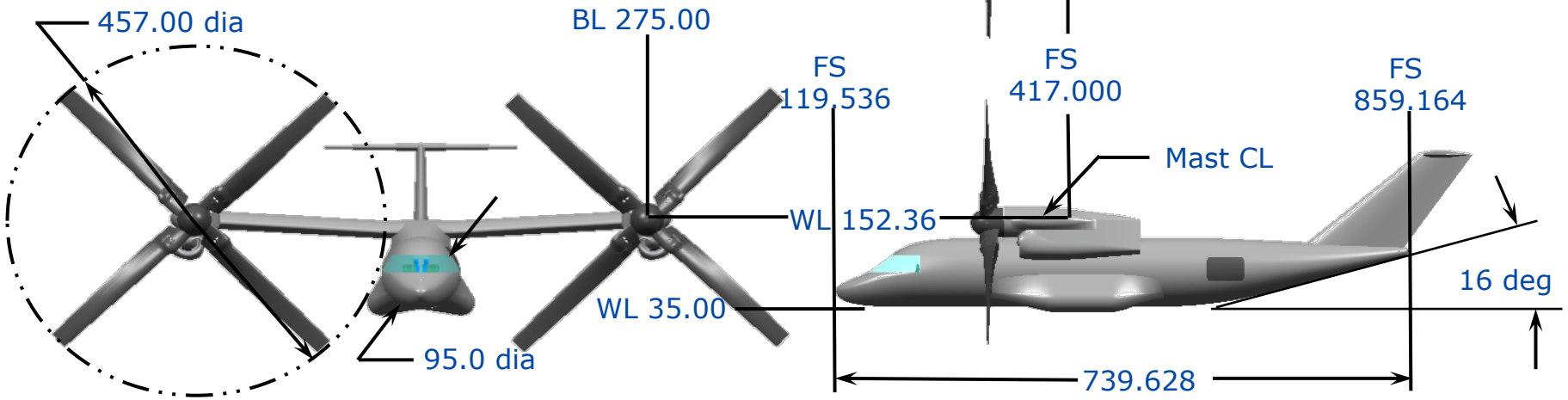
(1) VTOL is assumed to be a Cat A procedure and is a target for 10 and 30-pax designs
(2) Target

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30-Pax CTR Conceptual Design







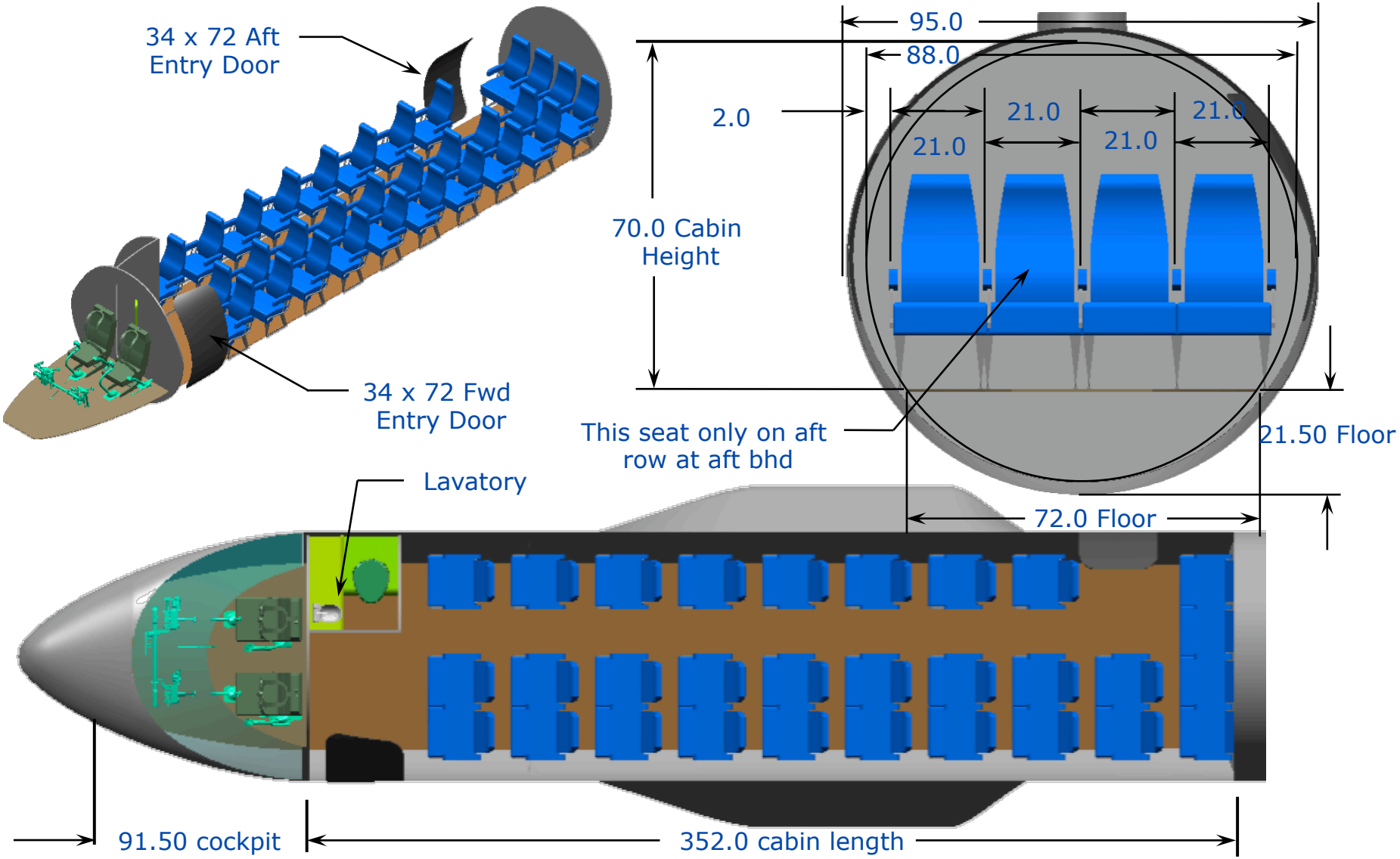
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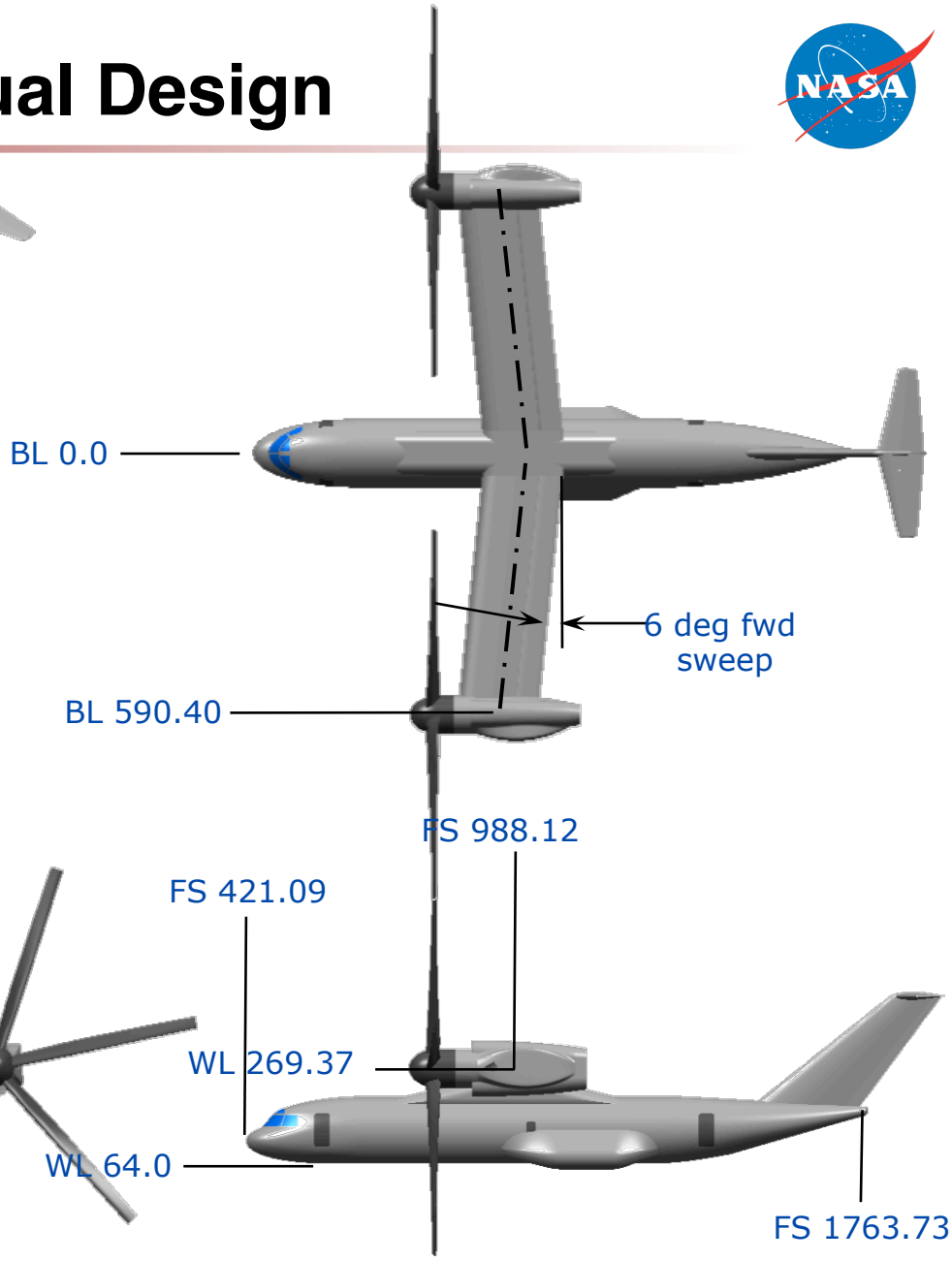
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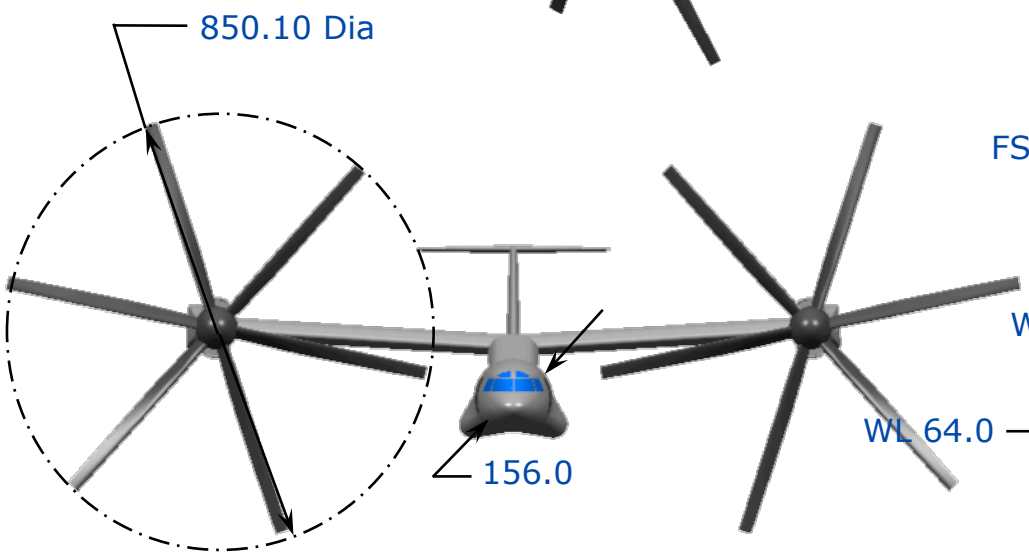
30-Pax CTR Cont.



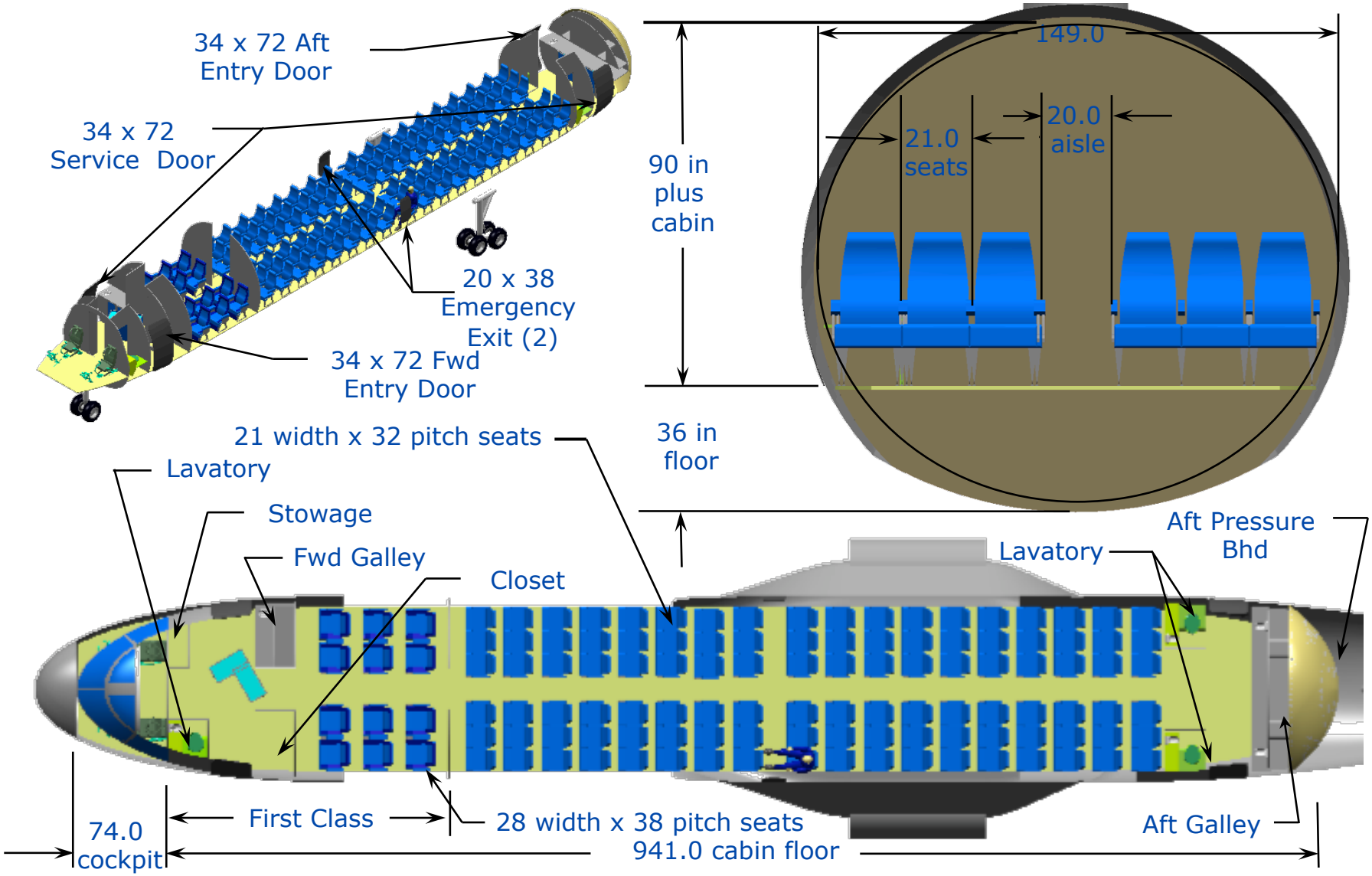
120-PAX CTR Conceptual Design





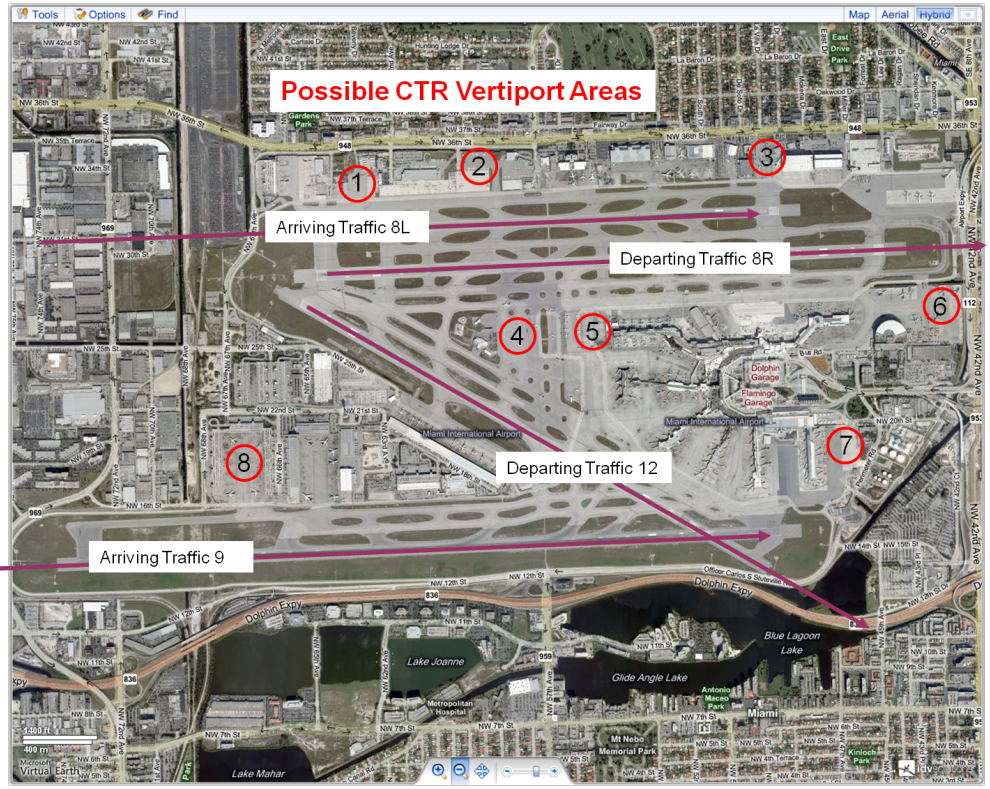


120-Pax CTR Cont.



Pilot-in-the-Loop Simulations

- Pilot-in-the-loop simulations were performed at Bell Helicopter
- Because of simulator logistics reasons terminal area simulations were at Miami airport (MIA)
- ACES airspace simulations, though, will focus primarily on Northeast Corridor
- Pilot-in-the-loop simulations tested applicable terminal area CONOPS
- Additionally, Bell simulator data was used to validate BADA/ACES models



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Fixed-Base Simulator used in PITL Sim



Coupled ACES/AvTerminal Simulations

- During Year 2 effort, CTR BADA models was transformed to ACES models
- ACES is a well-known NASA-developed airspace simulation tool
- AvTerminal is a Sensis-developed terminal area tool
- Airspace simulations are being used to assess impact of CTR fleet to increase capacity/throughput of congested airports in 2025 time frame
- Study primary focus will be on Northeast Corridor
- CTR fleet size for 2025 was based in part on demand modeling and informal team assessments



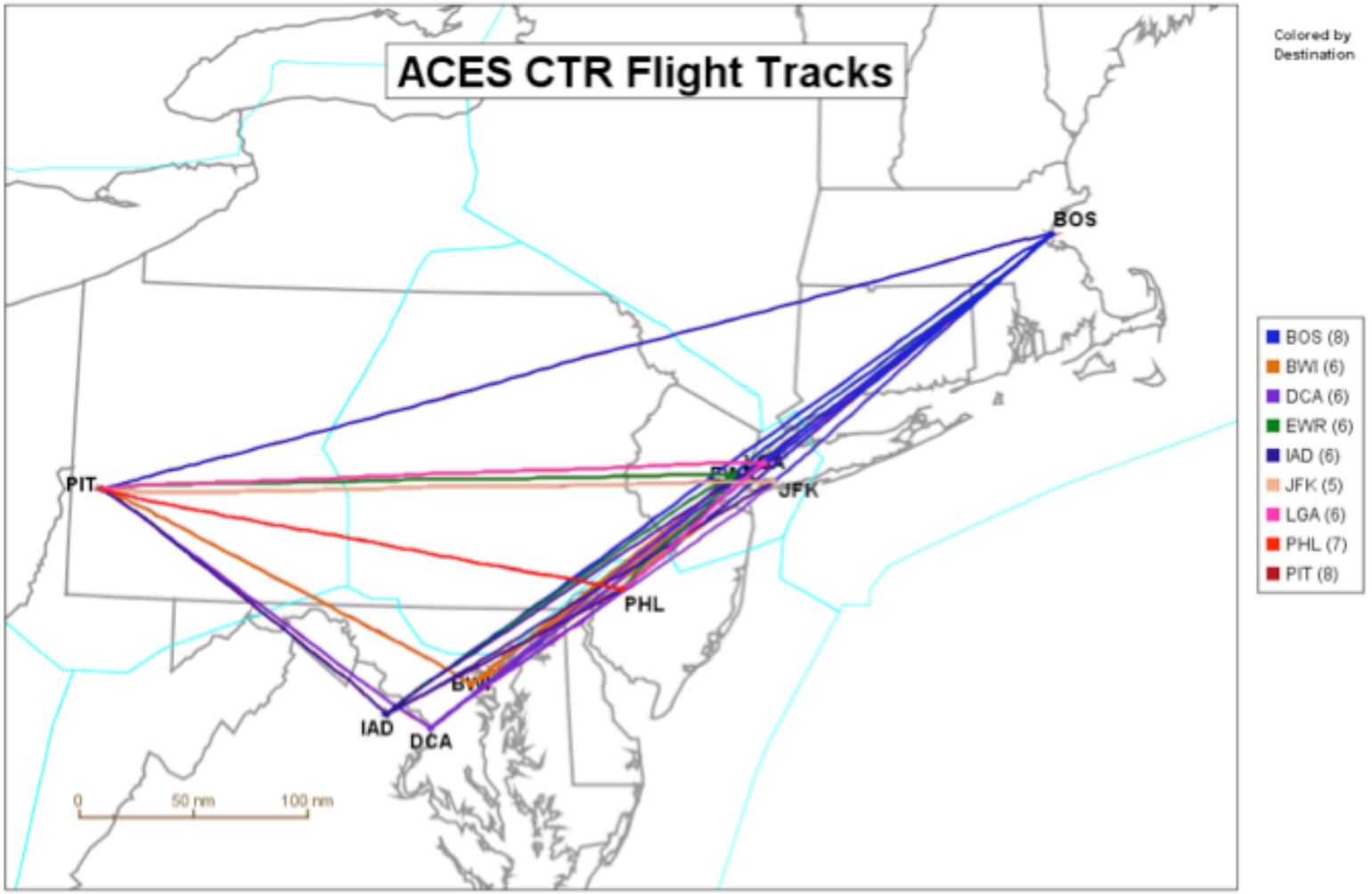
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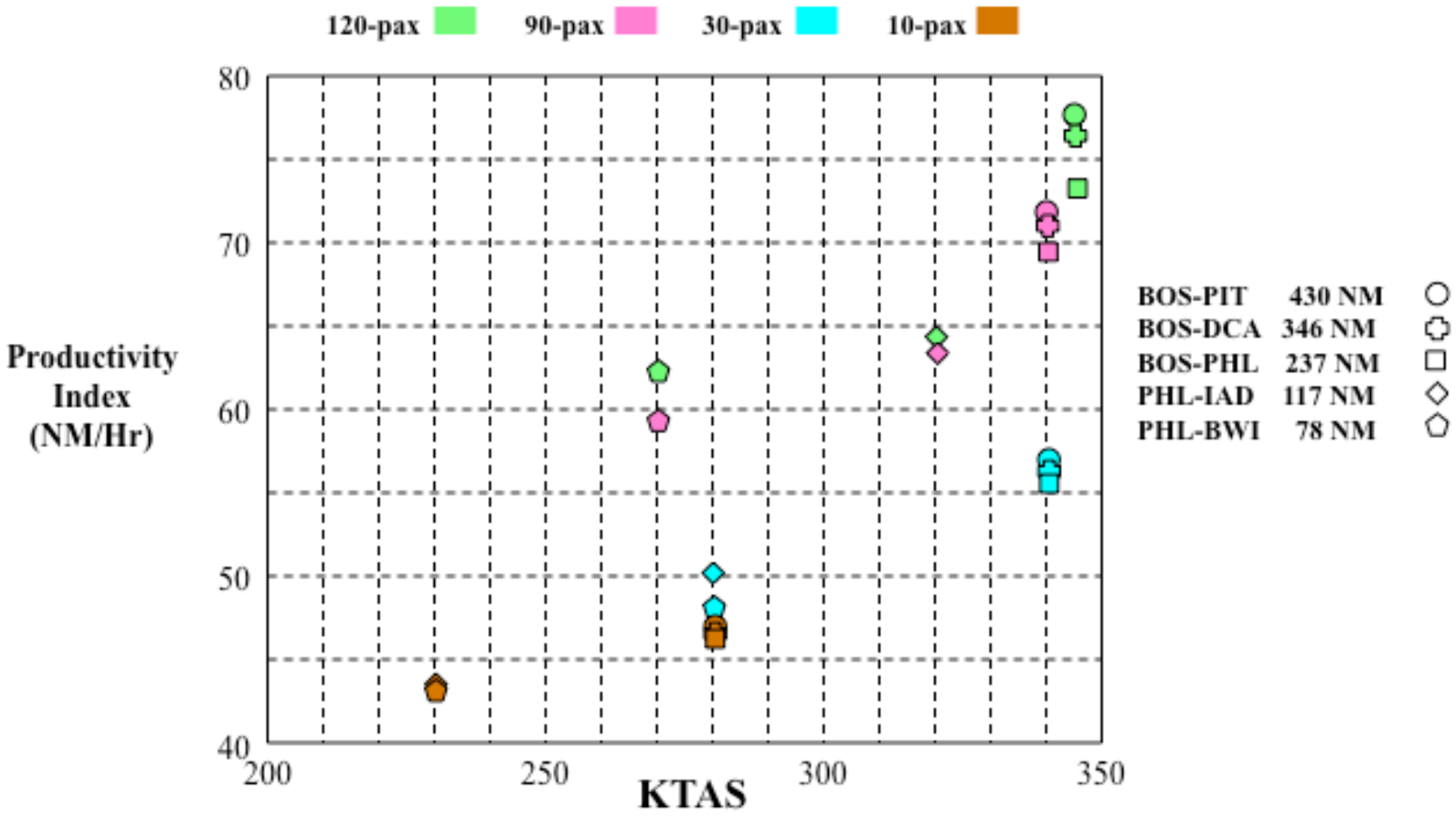
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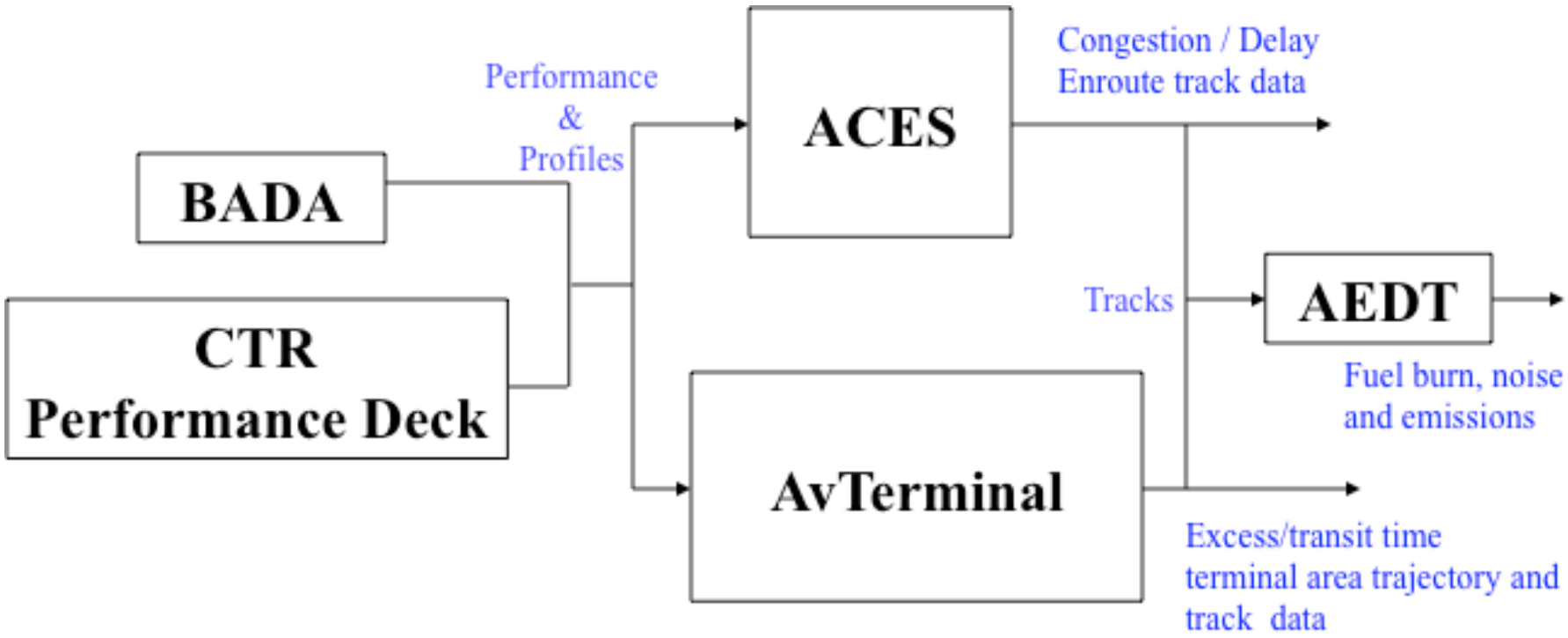
Northeast Corridor Nine Airport Network



“Productivity Index” to refine Flight Profiles



CTR Fleet Noise and Emissions Modeling



Future Plans -- CTR Public Service/Disaster Relief Modeling

- Public service missions are a singular and key aspect of rotorcraft; CTR will be no different
- During Year 3 effort, specialized simulation tools will be used to assess utility of CTR fleet for disaster relief missions
- Prototypical scenario to consider is a hurricane relief effort
- One possibility to consider in analysis is a CRAF-like (Civil Reserve Air Fleet) CTR civilian fleet response to disaster scenario



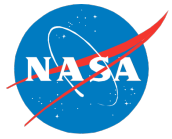
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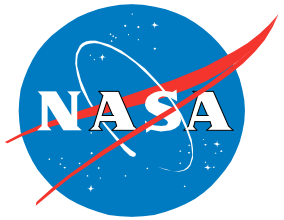
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Concluding Remarks



- A challenging but valuable exercise so far
- SRW-sponsored “CTR in Next Gen Airspace” study significantly leverages off Airspace Systems Program “Advanced Vehicles in Next Gen” NRA Studies
- Already gaining considerable insights from CTR conceptual design and pilot-in-the-loop sim efforts
- Coupled ACES/AvTerminal airspace simulations have begun



Questions?